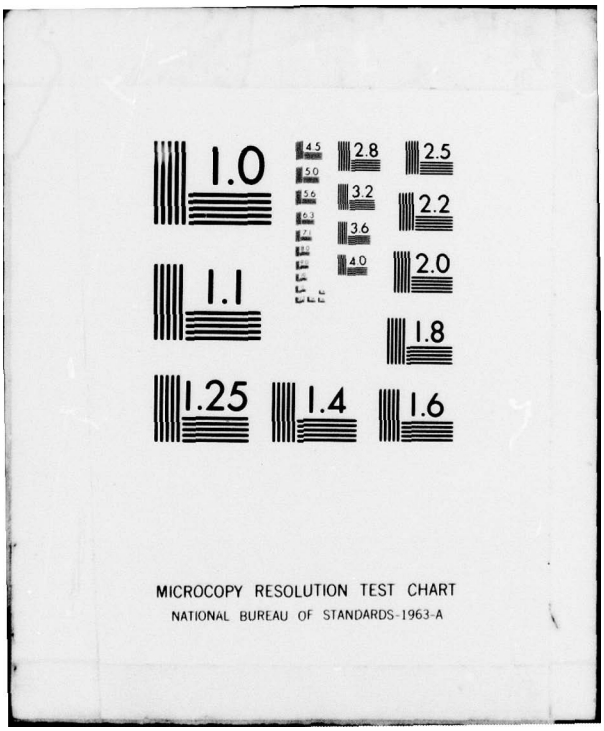
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NATIONAL DAM SAFETY PROGRAM. BIRCHWOOD LAKE DAM (NJ 00168), PAS--ETC(U)
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PASSAIC RIVER BASIN
TROY BROOK, MORRIS COUNTY
NEW JERSEY

LEVEL II

BIRCHWOOD LAKE DAM

NJ 00168

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

New Jersey Dept. of Environmental Protection, Trenton 410 891

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DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Birchwood Lake Dam Morris County, NJ		5. TYPE OF REPORT & PERIOD COVERED (9) FINAL rept. 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) (10) Warren A. Guinan Guinan, Warren A. P.E.		8. CONTRACT OR GRANT NUMBER(s) (15) DACW61-79-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS Anderson-Nichols 6 Louden Rd. Concord, NH 03301		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106	(11)	12. REPORT DATE August 1979 13. NUMBER OF PAGES 45
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17. DISTRIBUTION STATEMENT (of t

(6) National Dam Safety Program. Birchwood Lake Dam (NJ 00168), Passaic River Basin, Troy Brook, Morris County, New Jersey. Phase 1 Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Spillway	Seepage
Flows	Birchwood Lake Dam, N.J.
Slope	National Dam Safety Program Report
Embankment	Structural Analysis

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

17 SEP 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Birchwood Lake Dam in Morris County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Birchwood Lake Dam, a high hazard potential structure, is judged to be in poor overall condition. Also, the spillway is considered seriously inadequate since 19 percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard of loss of life downstream from the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Investigate the seepage at the downstream toe and design and implement appropriate remedial measures.

(2) Specify and supervise procedures for removal of the trees, their roots, and brush on the downstream slope of the dam.

(3) Specify and implement appropriate remedial measures for the erosion on the downstream slope of the dam.

(4) Design and install adequate means to drain the reservoir in case of emergency.

c. Within thirty days from the date of approval of this report, a program should be initiated to check the condition of the dam periodically and monitor the seepage until remedial measures are effected.

d. Within three months from the date of approval of this report, trespassing on the downstream face of the dam should be controlled.

e. The following remedial actions should be completed within one year from the date of approval of this report:

(1) Establish a ground cover and maintain the dam, free of brush.

(2) Engage a professional engineer qualified in the design and inspection of dams to make a comprehensive technical inspection of the dam once every two years.

f. The legal implications of directing large flows out of the watershed during periods of high flow should be investigated within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

NAPEN-D
Honorable Brendan T. Byrne

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

1 Incl
As stated

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

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BIRCHWOOD LAKE DAM (NJ00168)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 16 May 1979 by Anderson-Nichols and Company, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Birchwood Lake Dam, a high hazard potential structure, is judged to be in poor overall condition. Also, the spillway is considered seriously inadequate since 19 percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard of loss of life downstream from the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended.

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Investigate the seepage at the downstream toe and design and implement appropriate remedial measures.

(2) Specify and supervise procedures for removal of the trees, their roots, and brush on the downstream slope of the dam.

(3) Specify and implement appropriate remedial measures for the erosion on the downstream slope of the dam.

(4) Design and install adequate means to drain the reservoir in case of emergency.

c. Within thirty days from the date of approval of this report, a program should be initiated to check the condition of the dam periodically and monitor the seepage until remedial measures are effected.

d. Within three months from the date of approval of this report, trespassing on the downstream face of the dam should be controlled.

e. The following remedial actions should be completed within one year from the date of approval of this report:

(1) Establish a ground cover and maintain the dam, free of brush.

(2) Engage a professional engineer qualified in the design and inspection of dams to make a comprehensive technical inspection of the dam once every two years.

f. The legal implications of directing large flows out of the watershed during periods of high flow should be investigated within six months from the date of approval of this report.

APPROVED: Joel Holladay LTC
JAMES G. TON
Colonel, Corps of Engineers
for District Engineer

DATE: 14 September 1979

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-D

13 SEP 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

This is in reference to our ongoing National Program for Inspection of Non-Federal Dams within the State of New Jersey. Birchwood Lake Dam (Federal I.D. No. NJ00168), a high hazard potential structure has recently been inspected. The dam is owned by the Borough of Mountain Lakes and is located on Troy Brook in Mountain Lakes.

Using Corps of Engineers' screening criteria, it has been determined that the dam's spillway is seriously inadequate since approximately 19 percent of the Probable Maximum Flood would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise, or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE unclassification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard potential to loss of life downstream from the dam. As a result of this UNSAFE determination, it is recommended that the dam's owner take the following measures within 30 days of the date of this letter:

a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.

b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, round-the-clock surveillance should be provided during periods of unusally heavy precipitation.

A final report on this Phase I Inspection will be forwarded to you within two months.

Sincerely,

Jul Kallahan LTC

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies Furnished:
Dirk C. Hofman, Actg. Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

UNSAFE DAM
NATIONAL PROGRAM OF INSPECTION OF DAMS

a. NAME: Birchwood Lake Dam

b. ID NO.: NJ00168

c. LOCATION State: New Jersey County: Morris
River or Stream: Troy Brook
Nearest D/S City or Town: Mountain Lakes

d. HEIGHT: 20 feet.

e. MAXIMUM IMPOUNDMENT CAPACITY: 105 ac ft.

f. TYPE: Earthfill.

g. OWNER: Borough of Mountain Lakes.

h. DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 13 Sep 79.

i. CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT Preliminary report calculations indicate 19% of PMF would overtop the dam.

l. URGENCY CATEGORY: UNSAFE, Non-Emergency.

m. EMERGENCY ACTIONS TAKEN:
Gov. notified of this condition by District Engineer's letter of 13 Sep 79.

j. DESCRIPTION OF DANGER INVOLVED:
Overtopping and failure of the dam would significantly increase hazard potential to loss of life and property downstream of dam.

h. REMEDIAL ACTIONS TAKEN:
N.J.D.E.P. will notify dam's owner upon receipt of our letter.

k. RECOMMENDATIONS GIVEN TO GOVERNOR:
Within 30 days of date of District Engineer letter the owner do the following:
a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtoppoing of the dam.
b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, around-the-clock surveillance should be provided during periods of unusually heavy precipitation.

o. REMARKS: Final report, to be issued within six weeks, will have WHITE cover.

W. H. ZINK, Coordinator
Dam Inspection Program
U.S.A.E.D., Philadelphia

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Birchwood Lake Dam
ID Number:	ID No. NJ00168
State Located:	New Jersey
County Located:	Morris
Stream:	Troy Brook
River Basin:	Passaic
Date of Inspection:	May 16, 1979

ASSESSMENT OF GENERAL CONDITIONS

Birchwood Lake Dam is an old dam of undetermined age and is in poor overall condition. It is small in size and is classified as High Hazard. A large rust colored seepage, estimated as 15 gpm, was observed at the toe of the dam. Trees and brush are growing on the downstream slope of the dam. The concrete junction box on the spillway discharge pipe is leaking and there is an undermining and erosion around the broken end of the discharge pipe. Erosion caused by trespassing is present on the downstream face of the dam.

The lake and dam are capable of passing 18 percent of the PMF without causing the dam to overtop. Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream over the non-failure condition. Thus the spillway is judged to be seriously inadequate.

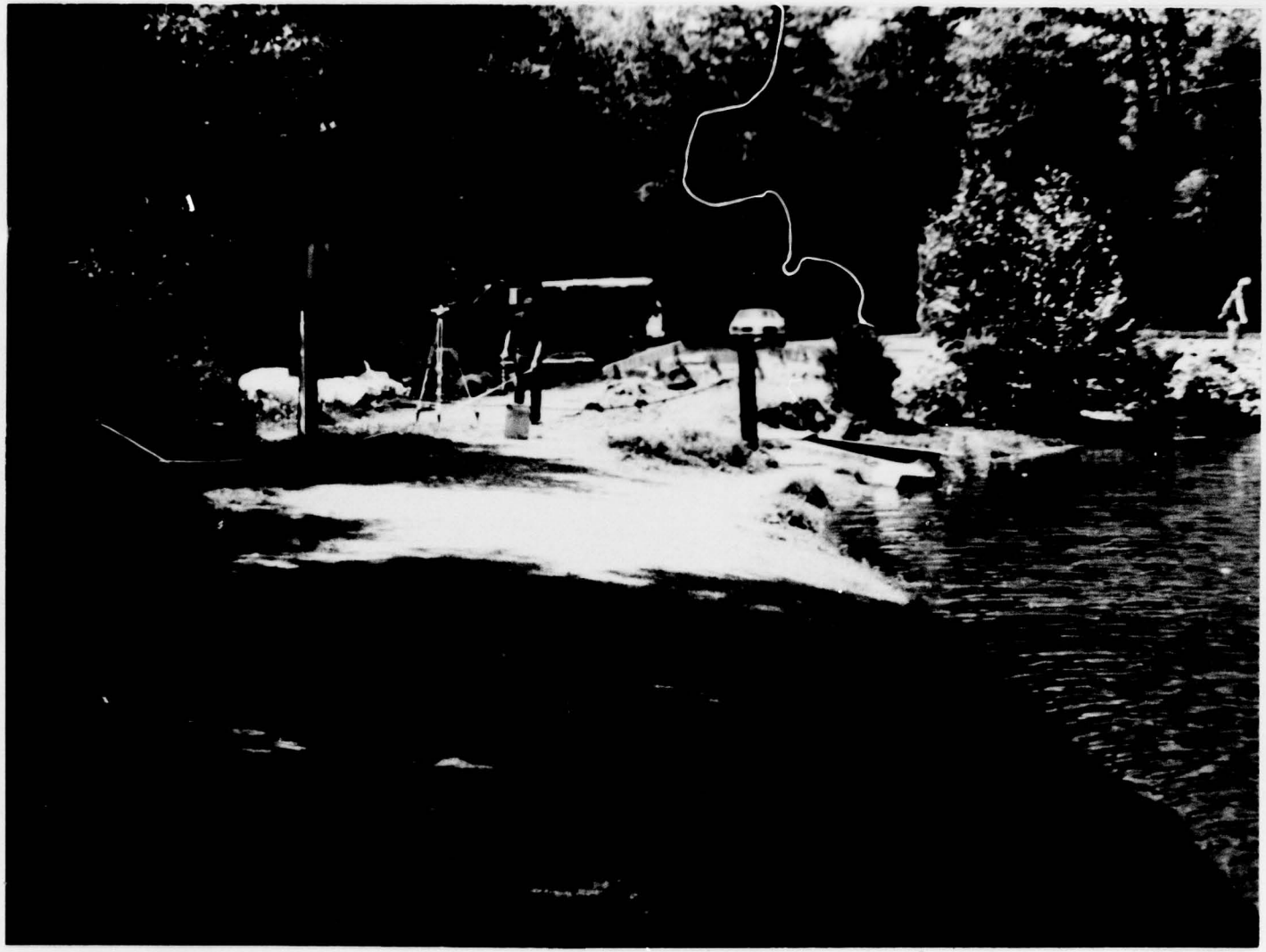
We recommend that the owner, in the near future, retain the services of a professional engineer, qualified in the design and inspection of dams, to accomplish the following: further evaluate the hydrology and hydraulic capacity of the watershed, reservoir, dam and spillway; and determine, design and implement mitigating measures determined necessary to provide the dam with the ability to withstand high discharges; investigate the seepage at the downstream toe of the dam and design and supervise the implementation of appropriate remedial measures; specify and supervise procedures for removing trees, their roots, and brush from the downstream slope of the dam; specify and implement appropriate remedial measures for the erosion on the downstream slope of the dam; and, in the future, design and install adequate means to drain the reservoir in case of emergency.

We further recommend that as a part of operating and maintenance procedures, the owner check the condition of the dam once each month and monitor the seepage until remedial measures are effected. This should be started immediately. Control trespassing on the downstream face of the dam. This should be started very soon. Establish a ground cover and maintain the

dam free of brush. This should be done in the future. Establish a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure. This should be done soon. Engage a professional engineer, qualified in the design and inspection of dams, to make a comprehensive technical inspection of the dam once every two years. This should be started in the future. Investigate the legal implications of directing large flows out of watershed during periods of high flows. This should be done in the future.

Warren A. Guinan

Warren A. Guinan, P.E.
Project Manager
N.J. No. 16848



16 MAY 1979

OVERVIEW
BIRCHWOOD LAKE DAM

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PHASE I INSPECTION REPORT
BIRCHWOOD LAKE DAM N.J. NO. 25-70 AND FED ID NO. NJ00168

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In review this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
BIRCHWOOD LAKE DAM
U.S. #NJ00168 and N.J. #25-70

SECTION 1 PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Birchwood Lake Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 4 April 1979 under Contract No. FPM-39 dated 28 June 1978. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc. on 16 May 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to the safety of Birchwood Lake Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Birchwood Lake Dam is an old (construction date unknown) earthfill dam, which is approximately 160 feet long, has a structural height of 20.3 feet and a hydraulic height of 18.8 feet. The topwidth of the dam is approximately 30 feet. The upstream face is of undetermined slope. The downstream face is 2H:1V. A concrete inlet box with a 2.5-foot high by 2.0-foot wide opening, gated with wood stoplogs, is located in the center of the dam. Concrete wingwalls six feet long and at 60 degree angles contract the flow to the inlet box. The box is covered with a steel plate which determines the minimum elevation of the dam (552.7 feet MSL). With 1.0 foot height of stoplogs in place at the time of the inspection the box opening was limited to 1.5 feet by 2 feet. From the inlet box, flow is discharged through 10-inch diameter AC pipe down the face of the dam to a concrete junction box, located about half way down the slope. From the junction box another 10-inch AC pipe carries the flow to Crystal Lake. The reservoir is surrounded by park land. The watershed above the reservoir is gently to steeply sloping and generally wooded. There is a natural low saddle at the north end of the reservoir which has a minimum elevation of 551.6 feet MSL, (cross-section included in Appendix 3) and will act as an emergency spillway during high flows. Flow over this saddle leaves the Troy Brook

watershed flowing through a sparsely populated area to the Rockaway River. A second natural low saddle is located on the southeast bank of reservoir north of the spillway and has a minimum elevation of 553.5 feet MSL. (Cross-section included in Appendix 3.) Flow over this saddle will be discharged directly to Crystal Lake. Essential features of the dam are shown in Figure 2.

b. Location. The dam is located in the Borough of Mountain Lakes, Morris County, New Jersey, at the headwaters of Troy Brook. It has coordinates north latitude 40° 53.6' and west longitude 74° 27.1'. A location map is shown in Figure 1.

c. Size Classification. Birchwood Lake Dam is classified as being small in size, as defined in the Recommended Guidelines for Safety Inspection of Dams, on the basis of its structural height of 20.3 feet, which is less than 40 feet, and its storage volume of 107 acre-feet which is less than 1000 acre-feet, but more than 50 acre-feet.

d. Hazard Classification. Visual inspection of the downstream area indicates that a breach of Birchwood Lake Dam would likely cause breaching of Crystal Lake and subsequent breaching of Sunset Lake Dam. Approximately 10 residences are located immediately below Sunset Lake Dam, some with first floor elevations below the normal pool level of the lake. A breach of Birchwood Lake Dam, would, therefore, likely cause excessive property damage and put up to 20 lives in jeopardy. Birchwood Lake Dam is thus classified as High Hazard.

e. Ownership. Birchwood Lake Dam is owned by the Borough of Mountain Lakes. Mr. Carl Danser, Superintendent of Public Works (334-3131) was contacted for information and was present during the inspection.

f. Purpose of Dam. The dam was originally constructed to impound an ice pond. Currently the reservoir and shores are heavily used for recreation.

g. Design and Construction History. No plans, hydraulic or hydrologic data for the original construction were disclosed. Reference data on file with the NJDEP dated 7 November 1928 indicates that the dam is old and was constructed by Mountain Ice Company. This is the oldest disclosed record regarding construction history of the dam.

h. Normal Operational Procedures. No formal operating procedures were disclosed.

1.3 Pertinent Data

a. Drainage Area - 0.2 square mile

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown

Gated spillway capacity at pool elevation with stoplogs in place (as during inspection)-0.5+

Gated spillway capacity at maximum pool (top of dam) elevation with stoplogs removed - 6 (controlled by pipe capacity)

Ungated spillway (north saddle) capacity at maximum pool elevation - 172

Total spillway capacity at maximum pool elevation - 178

c. Elevation (ft. above MSL)

Top dam - 552.7

Natural low saddle at north end of the lake - 551.6

Maximum pool - design surcharge (½ PMF) - 553.5

Recreation pool - (at the time of inspection) - 551.1

Spillway crest (stoplogs) - 551.0

Streambed at centerline of dam (Crystal Lake) - 533.9

Maximum tailwater - (estimated) - 537.7

d. Reservoir

Length of maximum pool - 1750 feet

Length of recreation pool - 1700 feet

e. Storage (acre-feet)

Recreation pool - 89

Design surcharge - 117

Top of dam - 106

Crest of north low saddle - 97.9

f. Reservoir Surface (acres)

Top of Dam - 11.2

Recreation pool - 11

Spillway crest - 11

g. Dam

Type - earthfill

Length - 160± feet

Height - hydraulic - 18.8 feet
structural - 20.3 feet

Topwidth - 30± feet

Side slopes - upstream - not visible
- downstream - 2H:1V

Zoning - unknown

Impervious core - unknown

Cutoff - unknown

Grout curtain - unknown

h. Spillway

Type - stoplog

Length of weir - 2.0 feet

Crest elevation - sill 550.0
- with stoplogs in place (as during inspection) 551.0

Gates - rough cut 2 x 4-inch by 2-foot long stoplogs.

U/S Channel - Birchwood Lake

D/S Channel - Crystal Lake

SECTION 2
ENGINEERING DATA

2.1 Design

No original engineering design data or plans were disclosed.

2.2 Construction

No original construction data were disclosed. Reconstruction of stone wall along south end of reservoir adjacent to spillway inlet was in progress at the time of inspection.

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. A search of New Jersey Department of Environmental Protection files and contact with community officials revealed a very limited amount of information.

b. Adequacy. The information available was such that the evaluation of this dam was based solely on visual observations.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. Dam. A large seepage is discharging from the downstream toe of the dam in the vicinity of the spillway discharge pipe. Flow was estimated at 15 gpm. Extensive trespassing and erosion on the downstream slope of the dam, especially in the vicinity of the spillway discharge pipe was observed. There is no riprap protection on the upstream slope. A new stone masonry retaining wall was being constructed in a shallow trench on the upstream edge of the crest of the dam at the time of the inspection. Brush and trees up to 2 feet in diameter are growing on the downstream slope of the dam.

b. Appurtenant Structures. The spillway discharge pipe has been exposed and partially undermined as a result of erosion on the downstream slope, and the discharge end of the pipe is broken. There is a leak in the concrete junction box which is located on the spillway discharge line at about mid-height of the downstream slope.

c. Reservoir Area. The reservoir is surrounded by park land and there is a bathhouse on the shore of the reservoir near the right abutment. The watershed above the reservoir is gently to steeply sloping and generally wooded. Slopes adjacent to the channel appear to be stable. No evidence of significant sedimentation in the reservoir was observed.

d. Downstream Channel. The spillway outlet pipe discharges directly into Crystal Lake; there is no downstream channel *per se*.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were disclosed.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were disclosed.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were disclosed.

4.4 Warning System

No description of any warning system was disclosed.

4.5 Evaluation of Operational Adequacy

Because of the lack of operation and maintenance procedures the remedial measures described in Section 7.2 c. should be implemented as prescribed.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. Design Data. No hydrologic or hydraulic design data were disclosed.

b. Experience Data. Reference data on file with NJDEP dated 7 November 1928 indicates that the dam was overtopped during 1928, and that damage to the dam has been repaired. No indication of downstream damage was given. No other experience data were disclosed.

c. Visual Observation. No visible evidence of damage to the structure caused by overtopping was observed. A large rust colored seepage estimated at 15 gpm was discharging from the downstream toe of the dam in the vicinity of the spillway discharge pipe. At the time of inspection about 1 inch of water was flowing over the stoplogs.

d. Overtopping Potential. The hydraulic/hydrologic evaluation for Birchwood Lake Dam is based on a Spillway Design Flood (SDF) equal to one-half the Probable Maximum Flood (PMF) in accordance with the range of test floods given in the evaluation guidelines for dams classified as high hazard and small in size. The PMF has been determined by application of the SCS dimensionless unit hydrograph procedure to a 6-hour PMP storm of 25.5 inches. Hydrologic computations are given in Appendix 3. The routed half-PMF peak discharge for the subject watershed is 753 cfs. Approximately 215 cfs of this discharge passes over the dam and through the spillway into Crystal Lake. The remaining 538 cfs passes through the low saddle at the north end of the lake and flows through a sparsely populated area into the Rockaway River.

The minimum elevation of the dam allows 2.7 feet of depth above the stoplogs before overtopping begins. Under this head the spillway discharge pipe capacity is 6 cfs. Under this same head the natural low saddle at the north end of the reservoir (minimum elevation 551.6 MSL) is discharging approximately 172 cfs toward the Rockaway River.

Routing calculations indicate that Birchwood Lake Dam will be overtopped for more than 2 hours to a miximum depth of 0.8 feet under half-PMF conditions. It is estimated that the spillway can pass 18 percent of the PMF without overtopping the dam. The spillway can pass less than 50 percent

of the PMF, and the dam is classified as High Hazard. Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from that which would exist just before overtopping failure, therefore the spillway for Birchwood Lake Dam is judged to be seriously inadequate.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The large seepage at the downstream toe of the dam, if not corrected, could lead to future instability of the dam. Trespassing, if not controlled, and erosion, if not repaired and controlled, could also lead to future instability of the dam. Trees growing on the embankment may blow over and pull out their roots, or, if they die or are cut, their roots may rot. In either case, serious erosion or seepage problems may result. The leak in the concrete junction box on the spillway discharge pipe, the broken end of the discharge pipe, and the undermining and erosion around the discharge pipe could all lead to further damage and plugging of the spillway discharge pipe if not corrected.

b. Design and Construction Data. No design or construction data pertinent to the structural stability of the dam were disclosed.

c. Operating Records. No operating records pertinent to the structural stability of the dam were disclosed.

d. Post-Construction Changes. No records pertinent to post-construction changes were disclosed.

e. Seismic Stability. Birchwood Lake Dam is in Seismic Zone 1 and in accordance with the recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Birchwood Lake Dam is an old dam of undetermined age and is in poor overall condition.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based solely on the results of the visual inspection.

c. Urgency. The recommendations made in Section 7.2 a. and the operating and maintenance procedures in 7.2 c. should be implemented by the owner as prescribed below.

d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems that are listed in Sections 5 and 6. These problems require the attention of a professional engineer qualified in the design and inspection of dams who will have to make additional engineering studies to design or specify remedial measures. If left unattended, the problems could lead to instability of the structure. Because the spillway is judged to be seriously inadequate, additional evaluation of the hydrology and the hydraulics of the dam, using more detailed methods is necessary.

7.2 Recommendations/Remedial Measures

a. Recommendations. The owner should retain the services of a professional engineer qualified in the design and inspection of dams to accomplish the following in the near future:

(1) Conduct a more detailed investigation of the hydrology and hydraulics of the watershed, reservoir, dam and spillway; and determine, design, and implement the necessary mitigating measures to provide the dam with the ability to withstand high discharges.

(2) Investigate the seepage at the downstream toe and design and implement appropriate remedial measures.

(3) Specify and supervise procedures for removal of the trees, their roots, and brush on the downstream slope of the dam.

(4) Specify and implement appropriate remedial measures for the erosion on the downstream slope of the dam.

(5) Design and install adequate means to drain the reservoir in case of emergency.

b. Operating and Maintenance Procedures. The owner should:

(1) Check the condition of the dam periodically and monitor the seepage until remedial measures are effected. This should be started immediately.

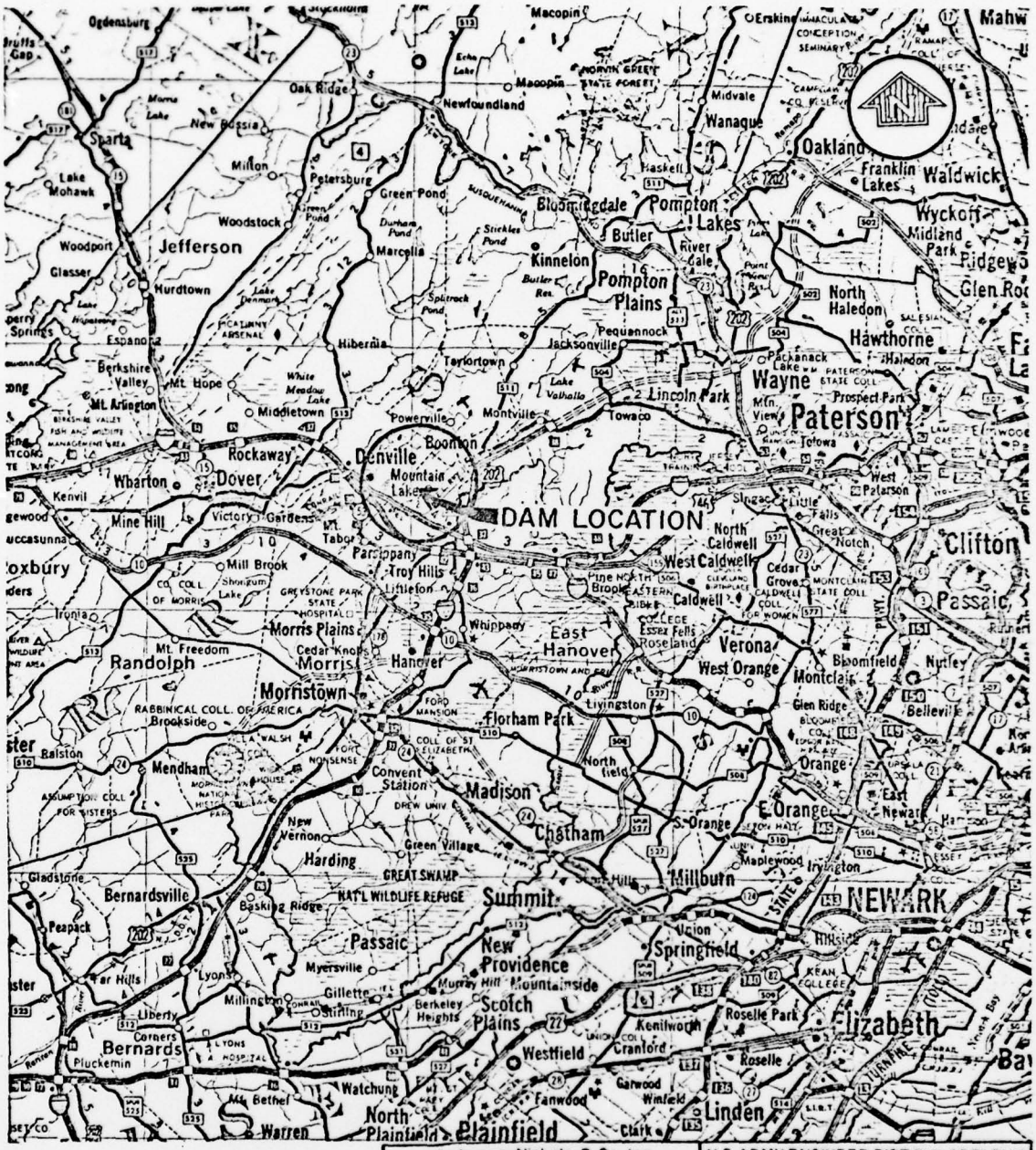
(2) Control trespassing on the downstream face of the dam. This should be started very soon.

(3) Establish a ground cover and maintain the dam, free of brush after completion of a.(3) above in the future.

(4) Establish a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure. This should be done soon.

(5) Engage a professional engineer qualified in the design and inspection of dams to make a comprehensive technical inspection of the dam once every two years. This should be started in the future.

(6) Investigate the legal implications of directing large flows out of the watershed during periods of high flow.



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BOSTON MASSACHUSETTS	

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BIRCHWOOD LAKE DAM
LOCATION MAP

TROY BROOK NEW JERSEY

SCALE: SEE BAR SCALE

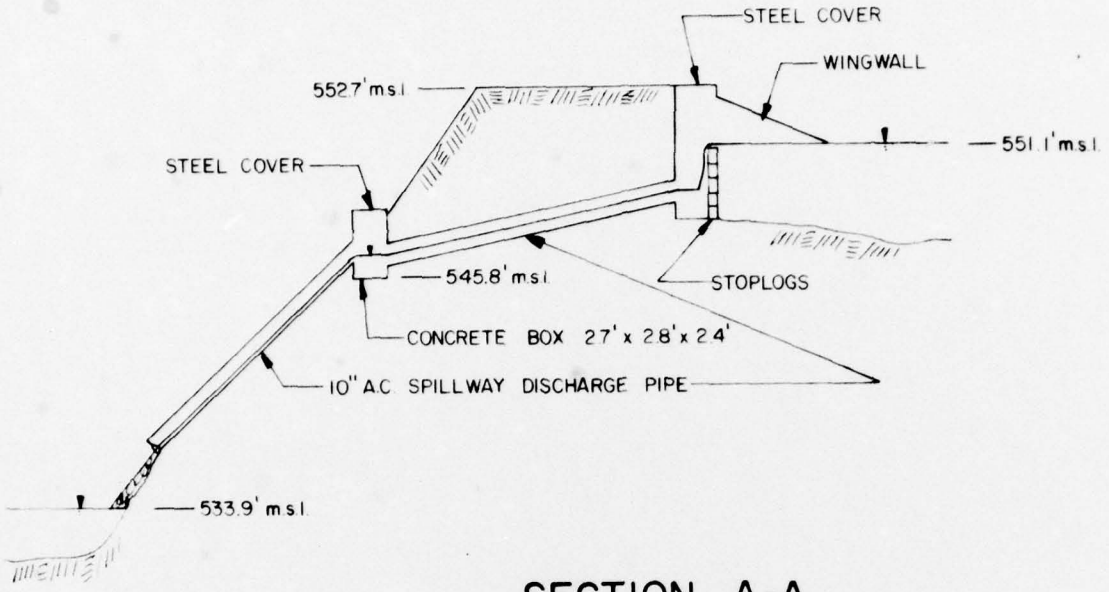
DATE: AUGUST 1979

SCALE IN MILES

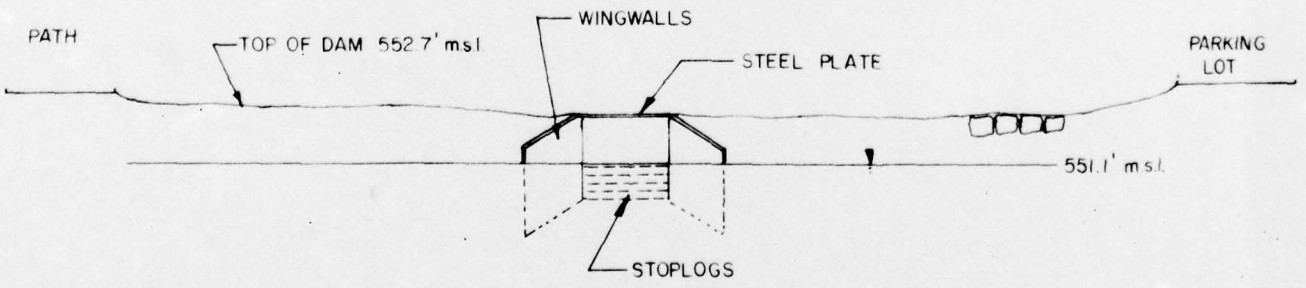
0 5 10

MAP BASED ON STATE OF NEW JERSEY OFFICIAL HIGHWAY MAP AND GUIDE.

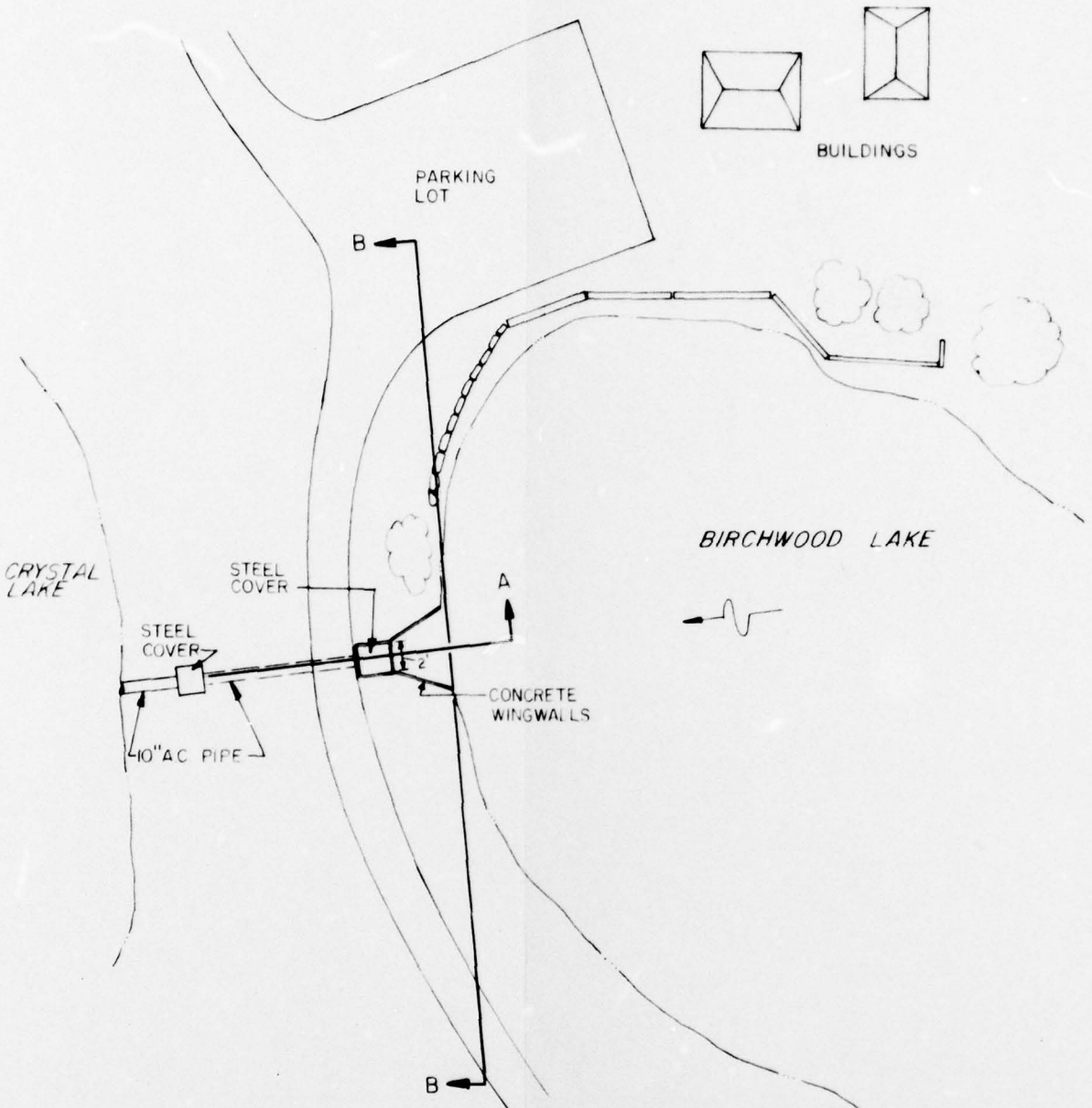
FIGURE 1



SECTION A-A



ELEVATION B-B



PARKING LOT

PLAN

2

Data from field inspection May 16, 1979

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NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BIRCHWOOD LAKE DAM

TROY BROOK NEW JERSEY

SCALE: NOT TO SCALE

DATE: AUGUST, 1979

FIGURE 2

APPENDIX 1

CHECKLIST

VISUAL INSPECTION

BIRCHWOOD LAKE DAM

Check List
Visual Inspection
Phase 1

Name Dam Birchwood Lake Dam County Morris State New Jersey Coordinators NJDEP

Date(s) Inspection May 16, 1979 Weather Sunny Temperature 65°

Pool Elevation at Time of Inspection 551.1 MSL Tailwater at Time of Inspection 533.9 MSL

Inspection Personnel:

Warren Guinan	Ronald Hirschfeld
Steve Gilman	
David Deane	

Gilman & Hirschfeld Recorder

Carl Danser, Superintendent of Public Works for the Borough of Mountain Lakes was present during inspection.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None apparent.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None apparent.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Considerable erosion of downstream slope at location of spillway discharge pipe, crushed rock has been dumped next to pipe, also evidence of trespassing and erosion of downstream slope to right of spillway.	Repair spillway discharge pipe. Provide appropriate slope protection.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good.	
RIPRAP FAILURES	No riprap.	Provide appropriate slope protection.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS		
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No apparent problems.	
ANY NOTICEABLE SEEPAGE	Major seepage to left of spillway discharge pipe and to right of discharge pipe. Estimated flow - 15 gpm.	Investigate seepage; design and implement appropriate control measures.
STAFF GAGE AND RECORDER	None apparent.	
DRAINS	None apparent.	

UNGATED SPILLWAY - Northeast Saddle

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None.	
APPROACH CHANNEL	Wide and generally unobstructed. Many water plants in north end of reservoir.	
DISCHARGE CHANNEL	Wide, forested, parabolic shape channel with very gentle slope leading to Rockaway River tributary	
BRIDGE AND PIERS OVER SPILLWAY	None.	

GATED SPILLWAY - 10-inch Pipe and Stoplog Entrance

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL 10" concrete walls with 10' @ u/s face of wingwalls	Concrete - Good condition only surface laitance eroded. Steel plate on top - good condition - surface rust only. 10" AC outlet pipe-good condition. Concrete block - pipe structure - block & joints weathered - leakage around outlet pipe - steel top plate rusted	
APPROACH CHANNEL	Wide. Three docks extend part way across channel.	
DISCHARGE CHANNEL	Spillway pipe discharges directly into Crystal Lake.	
BRIDGE AND PIERS	None.	
GATES AND OPERATION EQUIPMENT	Wood stoplogs - weathered and deteriorated	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle, wooded.	
SEDIMENTATION	No evidence of significant sedimentation.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Crystal Lake is at toe of downstream slope.	
SLOPES	See above.	
APPROXIMATE NO. OF HOMES AND POPULATION	10 residences, estimated population of 20, below Sunset Lake Dam. Several have first floor elevations below Sunset Lake normal water level.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	No original plans were disclosed. Plans for this report were developed from visual inspection.
REGIONAL VICINITY MAP	Prepared for this report.
CONSTRUCTION HISTORY	None disclosed.
TYPICAL SECTIONS OF DAM	Prepared for this report from visual inspection.
HYDROLOGIC/HYDRAULIC DATA	None disclosed.
OUTLETS - PLAN	None disclosed.
- DETAILS	None disclosed.
- CONSTRAINTS	None disclosed.
- DISCHARGE RATINGS	None disclosed.
RAINFALL/RESERVOIR RECORDS	None disclosed.

ITEM	REMARKS
DESIGN REPORTS	None disclosed.
GEOLOGY REPORTS	None disclosed.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None disclosed.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None disclosed.
POST-CONSTRUCTION SURVEYS OF DAM	None disclosed.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SERVICES	Unknown.
MODIFICATIONS	None disclosed.
HIGH POOL RECORDS	None disclosed.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None disclosed.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None disclosed.
MAINTENANCE OPERATION RECORDS	None disclosed.

ITEM	REMARKS
SPILLWAY PLAN	No original plans were disclosed.
SECTIONS	Cross-section for this report was prepared from visual inspection.
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	None.

BIRCHWOOD LAKE
CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 0.2 sq. mi., hilly, wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY) 551.1 ft. MSL (89 ac-ft)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY: Not applicable

ELEVATION MAXIMUM DESIGN POOL: 553.5 ft. MSL (117)

ELEVATION TOP DAM: 552.7 ft. MSL

CREST: Stoplog section

a. Elevation 551 ft. MSL

b. Type Stoplog

c. Width 3 inches

d. Length 2 feet

e. Location Spillover South end of Reservoir

f. Number and Type of Gates None

OTHER OUTLETS: Natural emergency spillway

a. Type Natural Low Saddle

b. Location Northeast end of Reservoir

c. Invert Elevation 551.6 ft. above MSL

d. Emergency Draindown Facilities None

HYDROMETEORLOGICAL GAGES: None

a. Type

b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 178 cfs

APPENDIX 2

PHOTOGRAPHS

BRICHWOOD LAKE DAM



16 MAY 1979

VIEW OF THE DAM CREST LOOKING SOUTH FROM RESERVOIR



16 MAY 1979

VIEW OF INLET TO SPILLWAY DISCHARGE PIPE



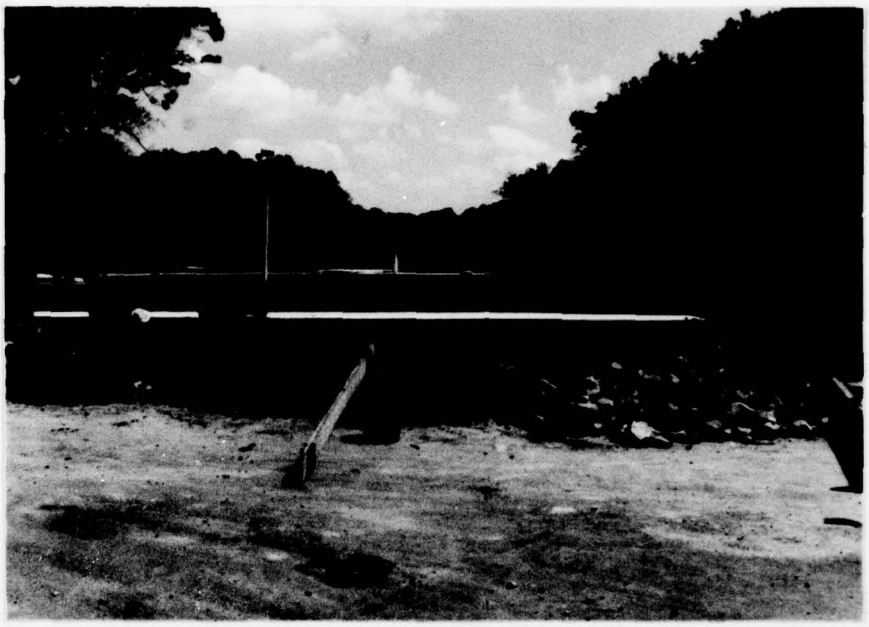
16 MAY 1979

SPILLWAY PIPE DISCHARGING INTO COLLECTION BOX ABOUT HALFWAY DOWN DOWNSTREAM SLOPE



16 MAY 1979

VIEW LOOKING UPSTREAM ALONG SPILLWAY DISCHARGE PIPE



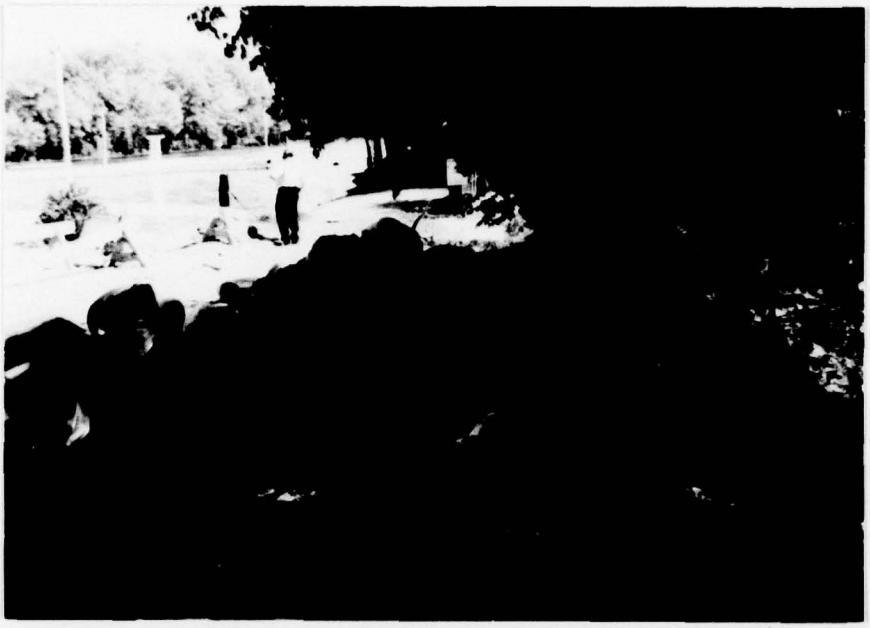
16 MAY 1979

VIEW OF BIRCHWOOD LAKE LOOKING NORTH FROM CREST



16 MAY 1979

VIEW LOOKING DOWN ON CRYSTAL LAKE FROM TOE OF DAM AT SPILLWAY DISCHARGE PIPE



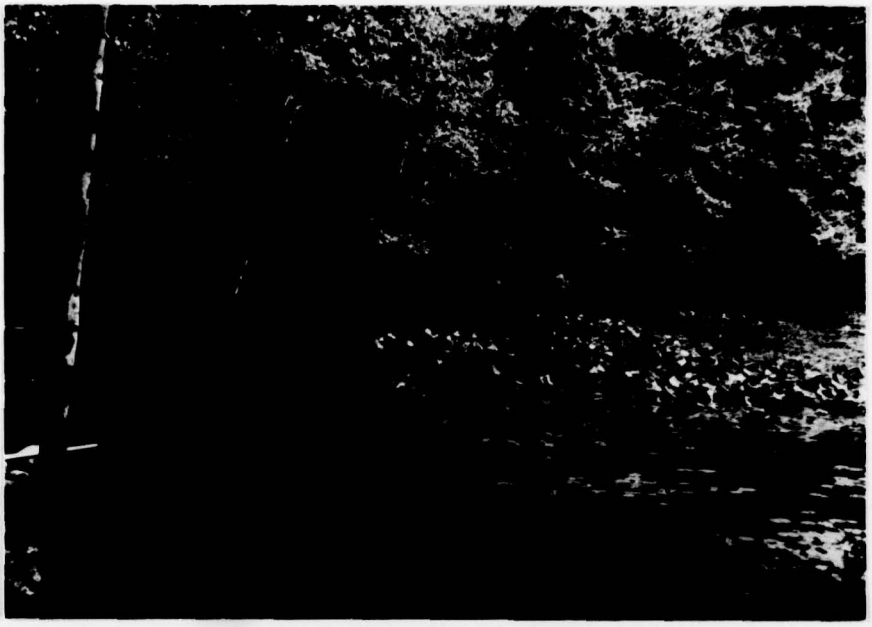
16 MAY 1979

VIEW ACROSS THE DAM CREST LOOKING NORTH



16 MAY 1979

VIEW OF LOW SADDLE ON SOUTHEAST BANK OF RESERVOIR NORTH OF SPILLWAY



16 MAY 1979

VIEW OF LOW SADDLE AT NORTH END OF THE LAKE



16 MAY 1979

VIEW OF LOW SADDLE AT NORTH END OF THE LAKE VIEWED FROM WEST BANK



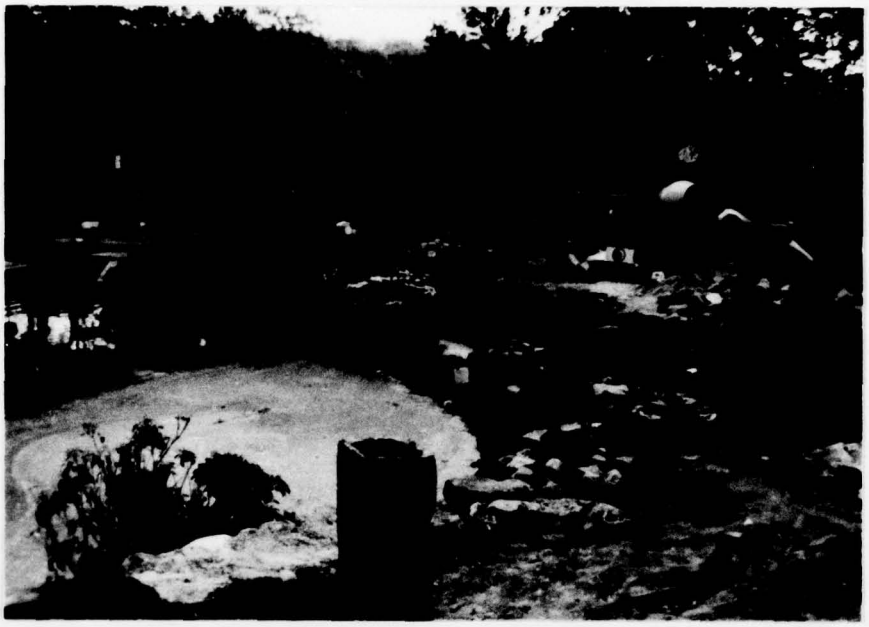
16 MAY 1979

OUTLET OF SPILLWAY DISCHARGE PIPE



16 MAY 1979

SEEPAGE AREA AT DOWNSTREAM SLOPE LOOKING TOWARD CRYSTAL LAKE



16 MAY 1979

RECONSTRUCTION OF STONE WALL ALONG SOUTH END OF RESERVOIR ADJACENT TO SPILLWAY INLET



16 MAY 1979

VIEW ACROSS DOWNSTREAM SLOPE OF DAM JUST NORTH OF SPILLWAY PIPE

APPENDIX 3

HYDROLOGIC COMPUTATIONS

BIRCHWOOD LAKE DAM

Anderson-Nichols & Company, Inc.

Subject H&H

Sheet No. 1 of 17

Date

Computed

Checked FCD

JOB NO. 3290-02 BIRCHWOOD LAKE DAM

SQUARES 1/4 IN. SCALE

HYDROLOGIC COMPUTATIONS

BIRCHWOOD LAKE DAM

LOCATION : MORRIS COUNTY, N.J.

DRAINAGE AREA : 0.2 SQ. MILE

EVALUATION CRITERIA : SIZE – SMALL
HAZARD – HIGH

Anderson-Nichols & Company, Inc.

Subject 11 2 1

Sheet No. 2 of 17

Date

Computed

Checked FDD

JOB NO. 3290-03 BIRCHWOOD LAKE

SQUARES 1/4 IN. SCALE

BIRCHWOOD LAKE — COMPUTATION OF TIME OF CONCENTR.

	L	H	S
OVERLAND FLOW	~2300'	~150'	.0652

Tc - TIME OF CONCENTRATION

① BY KIRPICH NOMOGRAPH Tc = 8.8 MINUTES

② BY IZZARDS FORMULA

$$Tc = \frac{L^{1.115}}{7700\,H^{.38}} = \frac{2300^{1.115}}{7700 \times 150^{.38}} = 6.5 \text{ MINS}$$

③ BY EQUATION - CALIFORNIA CULVERT p. 71 DESIGN of SMALL DAM

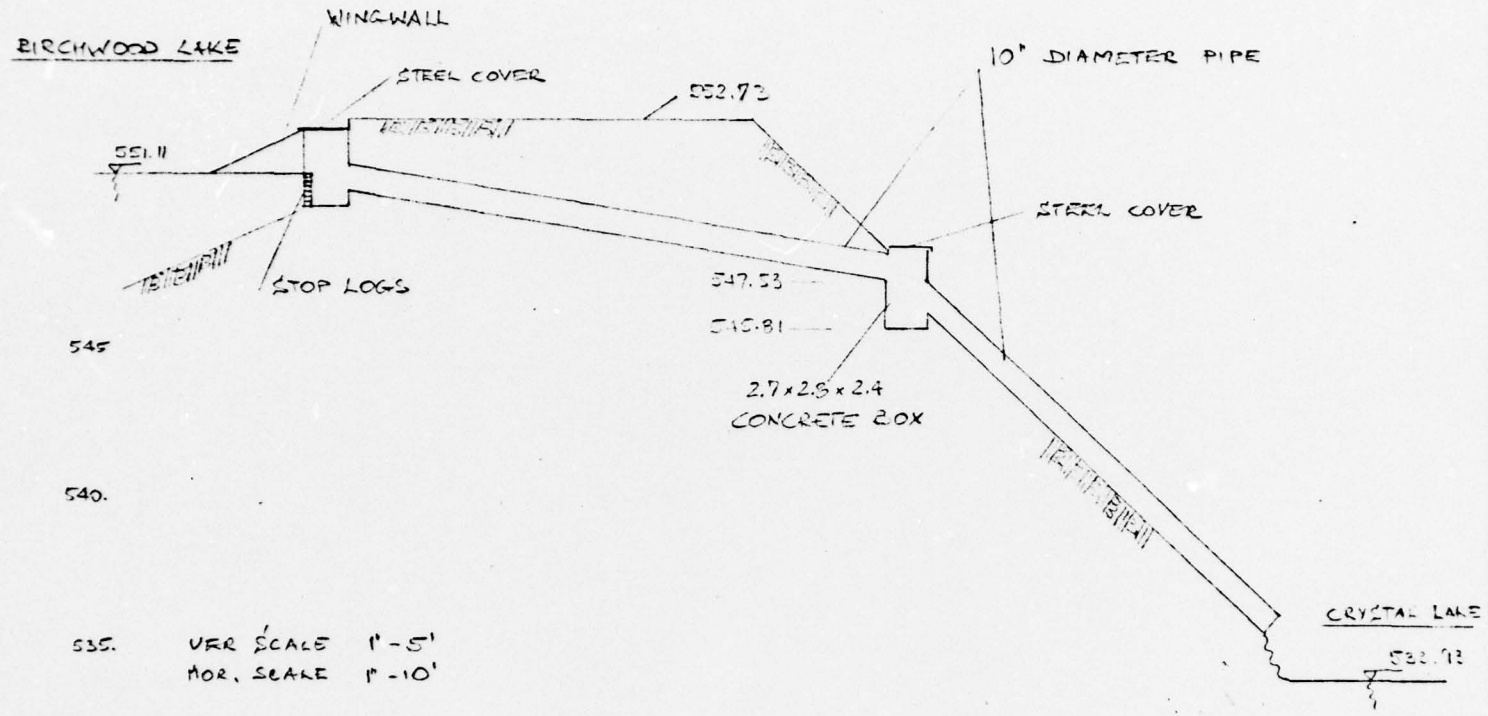
$$Tc = \left(\frac{11.9\,L^3\,[\text{MILES}]}{H\,[\text{FT}]}\right)^{.385} = \left(\frac{11.9 \times .4356^3}{150}\right)^{.385} = 8.7 \text{ MINS}$$

④ WESTON FORMULA

$$Tc = \frac{L}{3600\,V} = \frac{2300}{3600\ 2.5^{\text{ft/sec}}} = 15.3 \text{ MINS}$$

AVERAGE Tc = 10 MINUTES

BIRCHWOOD LAKE DAM — X-SECTION ACROSS THE DAM

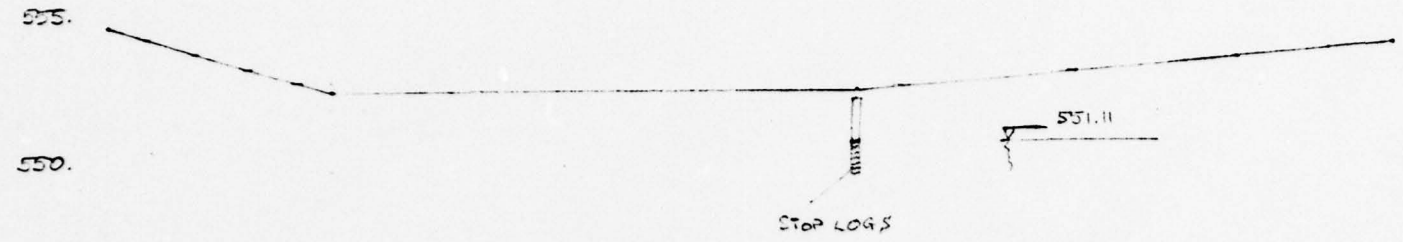


SHEET # 11
JOB # 3290-03
DATE: 06-21-79
COMPUTED BY: J.G.
CHECKED BY: [illegible]

SUBJECT: H/H.
ANDERSON - NICHOLS & CO. INC.
DATE: 06-21-79
COMPUTED BY: J.G.
CHECKED BY: FDS

JOB # 2290-03

BIRCHWOOD LAKE DAM - X SECTION ALONG DAM CREST



SUBJECT: #4 of 11

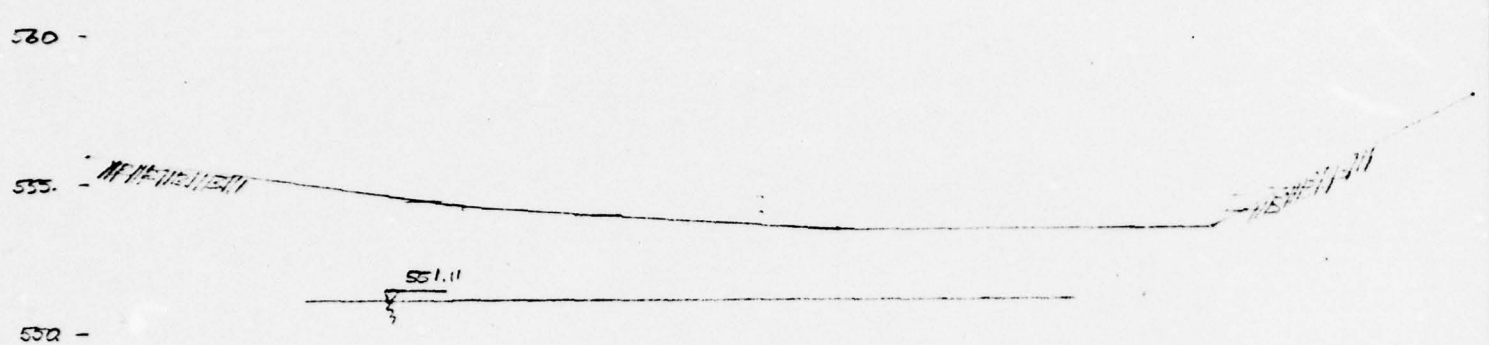
SDZ # 3290-03

DATE: 06-21-19

COMPUTED: JCJ

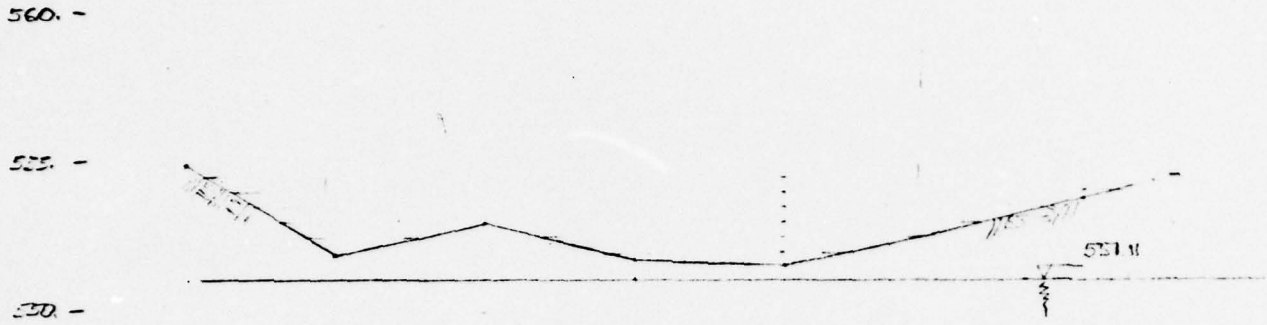
CHECKED: SDJ

BIRCHWOOD LAKE DAM – X-SECTION ALONG NATURAL LOW SPOT ON SOUTH BANK



SUBJECT H&H
JOB # 3290-03
DATE 06-20-79
COMPUTED JCJ.

BIRCHWOOD LAKE DAM – X-SECTION ALONG NATURAL LOW SPOT ON NORTHEAST BANK OF THE LAKE



VER. SCALE 1"-5'
HOR. SCALE 1"-20'

Anderson-Nichols & Company, Inc. Subject N.S.P. Sheet No. 7 of 17
JOB NO. 3290-03 BIRCHWOOD LAKE DAM Date 05-21- Computed Checked

SQUARES 1/4 IN. SCALE

BIRCHWOOD LAKE DAM - RATING CURVE COMPUTATIONS

DISCHARGE THROUGH THE PIPE ONLY (FIRST SECTION - FROM BIRCHWOOD LAKE TO COLECTOR BOX L=37')

L = 37'
S = 0.082
d = 10" (.83 FT)
A = .545 SQFT
NO PRESSURE FLOW!

n = 0.01

$Q = \frac{K'}{n} d^{8/3} S^{1/2}$

K' - FROM TABLE 7-14 , P. 7 BRATER & KING HANDBOOK OF HYDR.

ELEV.	K'	Q [CFS]
550.3	.0585	.93
551.0	.2160	3.44
551.2	.402	6.41
551.4	.496	7.92

PRESSURE FLOW

$Q = A\sqrt{\frac{2gh}{1+2K}}$

K_p - friction loss $K_p = \frac{5087 n^2}{d^{4/3}}$

ELEV.	h [FT]	Q [CFS]
551.6	4.1	5.2
551.8	4.3	5.4
552.0	4.5	5.5
552.2	4.7	5.6
552.4	4.9	5.75
552.6	5.1	5.87
552.8	5.3	5.99
553.	5.5	6.09

$K_p = .0285$
FRICTION LOSS = .0285 x 37 = 1.05
INLET LOSS $K_e = 0.78$
(FROM P. 5.5-2 SCS HYDRAULICS HANDBOOK)
$\Sigma K = 1.83$

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Subject M.S.H.

Sheet No. 8 of 17
Date 05-25-77
Computed
Checked

JOB NO. 3290-03

SQUARES 1/4 IN. SCALE

BIRCHWOOD LAKE DAM - RATING CURVE COMP. CONTINUE.

ELEV.	h [FT]	Q. [CFS]
552.5	6.	6.27
553.	6.5	6.63
553.5	7.	6.88
554.	7.5	7.12
554.5	8.0	7.35
555.	8.5	7.58
555.5	9.0	7.80
556.0	9.5	8.01

FLOW OVER THE STOP LOGS WEIR ONLY

[MIN. ELEV. 551.0 MSL]

$Q = C \cdot L \cdot H^{3/2}$ $C = 3.5$ $L = 2.0'$

ELEV.	h [FT]	Q. [CFS]
551.2	.2	.63
551.4	.4	1.77
551.6	.6	3.20
551.8	.8	5.0
552.0	1.0	7.0
552.2	1.2	9.2
552.5	1.5	12.8

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Subject H & H

Sheet No. 9 of 17
Date 06-25-79
Computed J.G.
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JOB NO. 2290-02 BIRCHWOOD LAKE DAM

SQUARES 1/4 IN. SCALE

FLOW OVER THE TOP OF THE DAM ONLY

[MIN. ELEV. 552.72 FT]

$Q = C \cdot L \cdot H^{3/2}$

$C = 2.8$

ELEV. [FT]	H. [FT]	L. [FT]	Q. [CFS]
553.0	.27	~82.	32.2
553.5	.77	~97.	183.
554.0	1.27	~120	480.
554.5	1.77	~140.	923.

FLOW OVER NATURAL LOW SPOT ON SOUTH BANK ONLY

[MIN. ELEV. 553.5 FT]

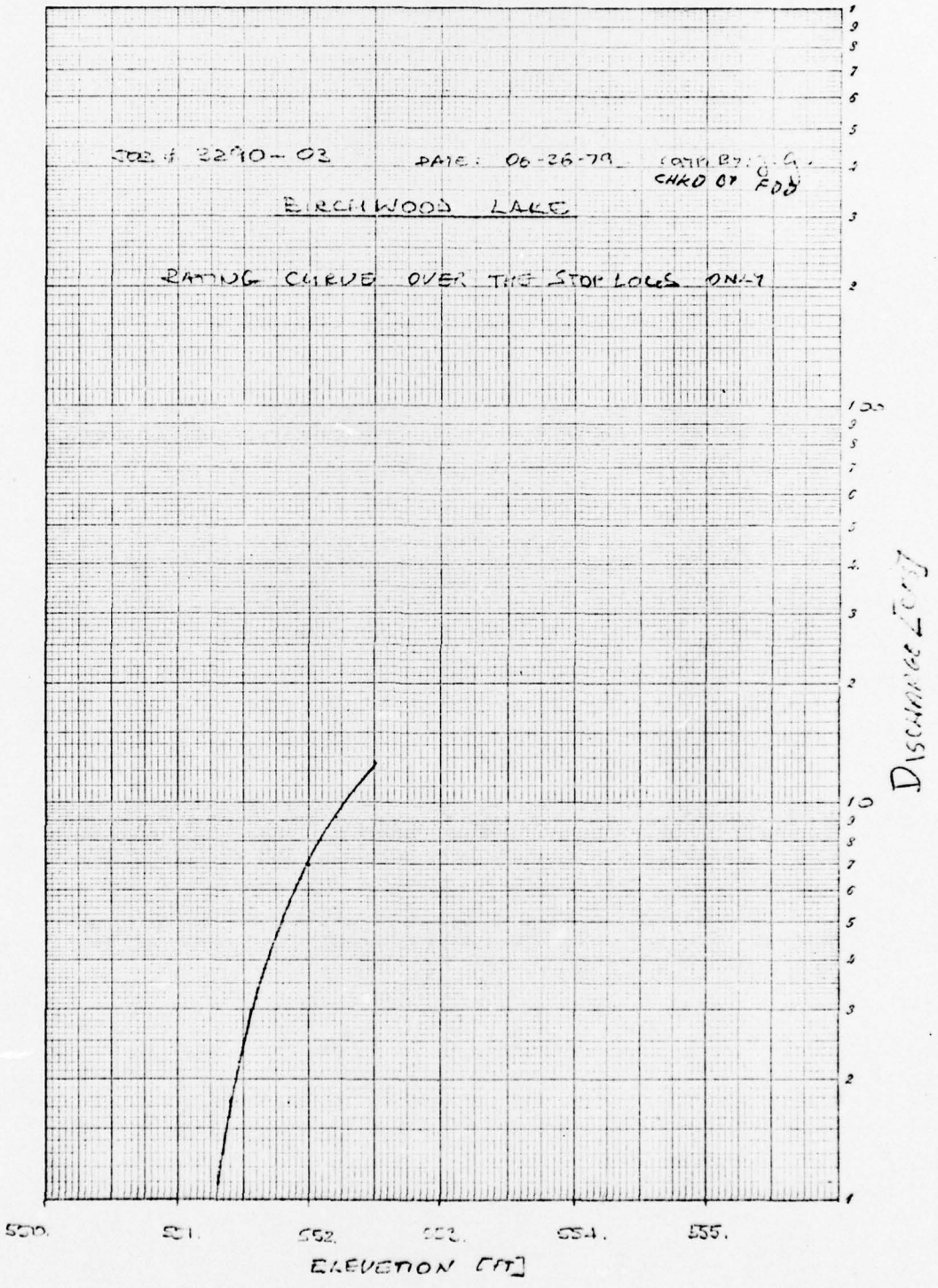
ELEV.	H [FT]	L [FT]	Q [CFS]
554.0	.5	~80.	79.2
554.5	1.0	~100.	280.

FLOW OVER NATURAL LOW SPOT ON NORTHEAST BANK ONLY

[MIN. ELEV. 551.6 FT]

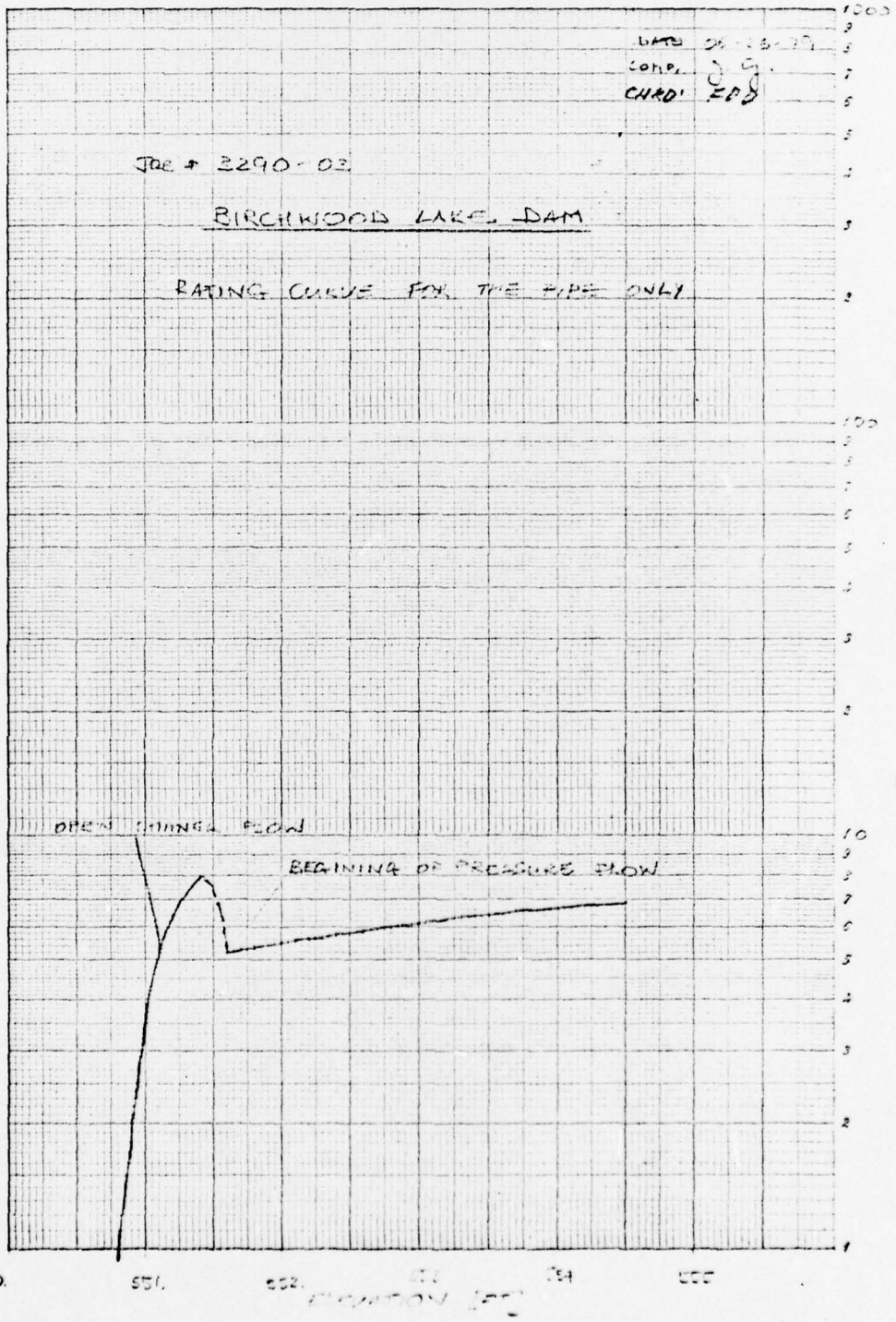
ELEV. [FT]	H. [FT]	L. [FT]	Q. [CFS]
552.	.4	~25.	17.7
552.5	.9	~40.	95.6
553.0	1.4	~55.	255.
553.5	1.9	~70	513.
554.0	2.4	~80.	833.
554.5	2.9	~85	1175.

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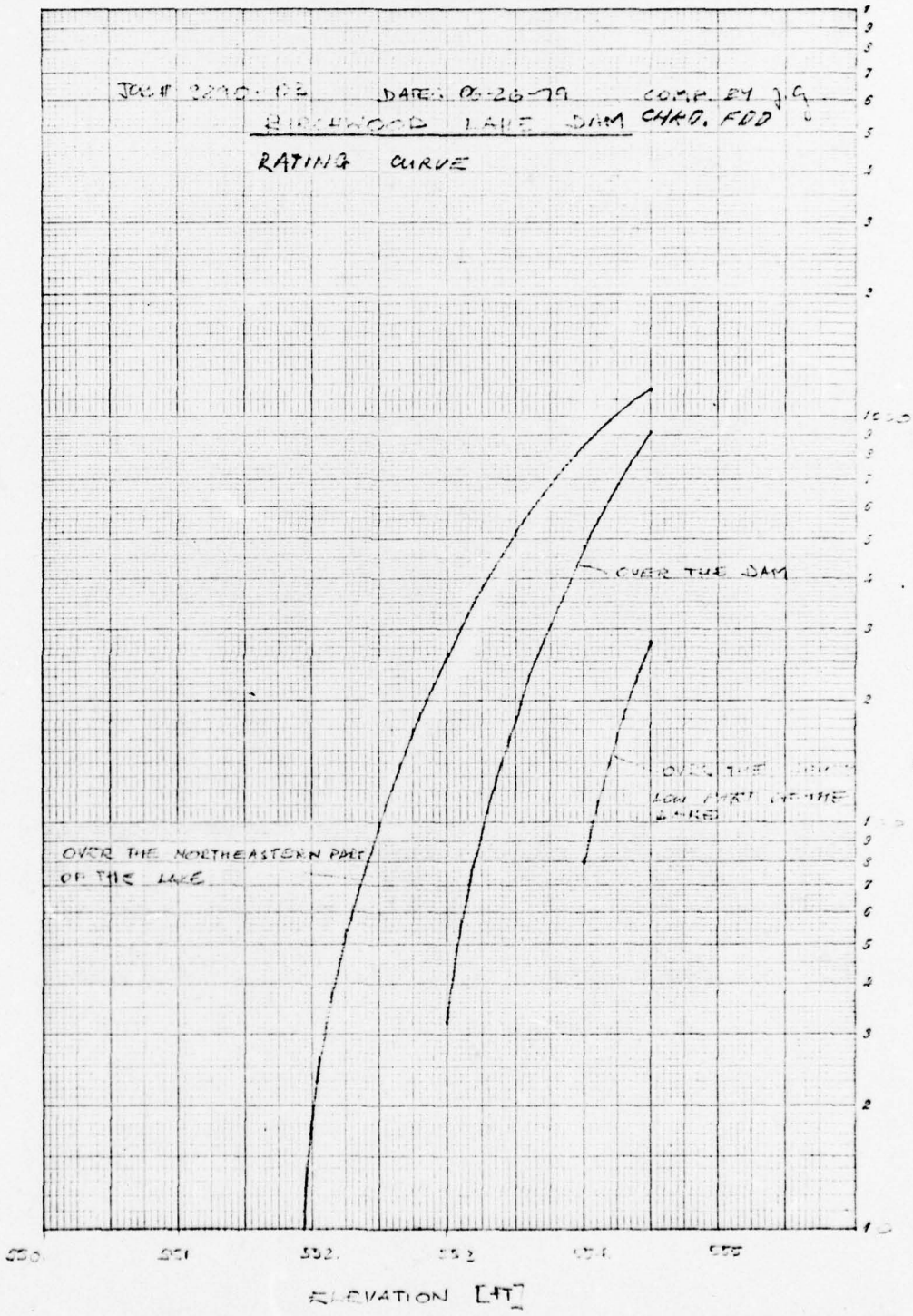
NO. 3115-R. 20 DIVISIONS PER INCH (120 DIVISIONS) BY 3-INCH CYCLES RATIO RULING. KEUFFEL & ESSER CO. IN STOCK DIRECT FROM CONN'S HOOK CO., NORWOOD, MASS. 02062 GRAPH PAPER PRINTED IN U.S.A.

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NO. 3115-R. 20 DIVISIONS PER INCH (120 DIVISIONS) BY 3 3-INCH CYCLES RATIO RULING. CODEX GRAPH PAPER IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 PRINTED IN U.S.A.

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NO. 3115 R. 20 DIVISIONS PER INCH (120 DIVISIONS) BY 3-INCH CYCLES RATIO RULING. EUCLID IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 GRAPH PAPER PRINTED IN U.S.A.

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Anderson-Nichols & Company, Inc.

Subject 41 of 41

Sheet No. 12 of 17
Date 06-26-74
Computed
Checked E.W.D.

JOB NO. 3290-03 BIRCHWOOD LAKE DAM

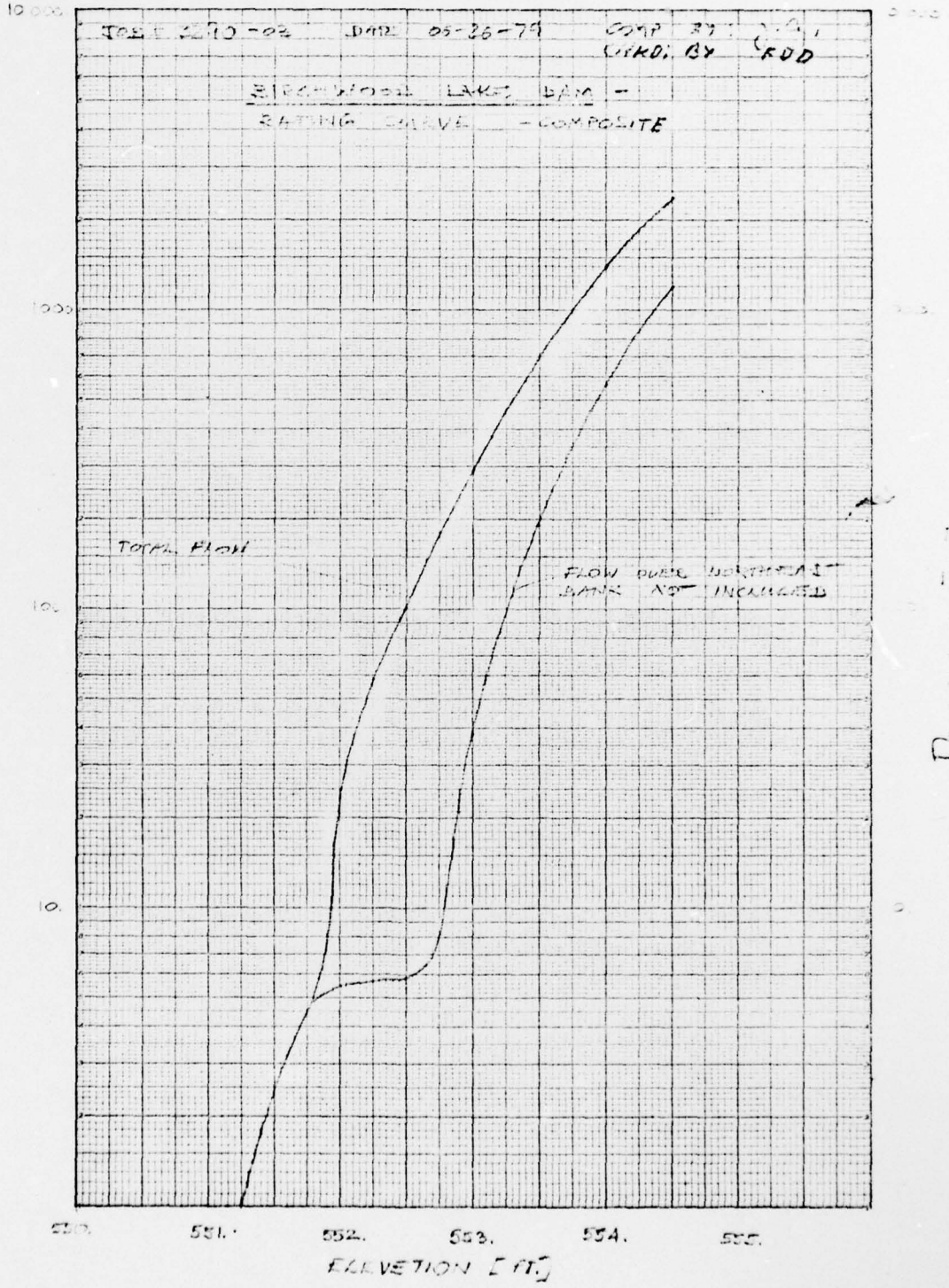
SQUARES 1/4 IN. SCALE

BIRCHWOOD LAKE DAM - RATING CURVE COMPUTATION

SUMMARY OF DISCHARGES

ELEV.	STOP-LOGS	PIPE	OVER NORTHEAST PART OF THE LAKE	TOP OF THE DAM	OVER SOUTH LOW PART OF THE LAKE	TOTAL [cfs]	DISCHARGE WITHOUT THE LOW PART OF THE LAKE
551.2	.63					.63	.63
551.4	1.77					1.77	1.77
551.6	3.20					3.20	3.20
551.8	5.0					5.0	5.0
552.0		5.5	17.7			23.2	5.5
552.5		5.8	95.6			101.4	5.8
553.0		6.1	265.	22.2		293.3	28.2
553.5		6.4	513.	183.5		702.9	189.9
554.0		6.6	833.	480.	79.2	1395.8	485.8
554.5		6.9	1175.	923.	280.	2384.9	1209.9

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NO. 31.226. 20 DIVISIONS PER INCH (120 DIVISIONS) BY FOUR CYCLES RATIO RULING. KEUFFEL & ESSER CO. GRAPH PAPER IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 PRINTED IN U.S.A.

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Anderson-Nichols & Company, Inc. Subject H & H

Sheet No. 15 of 17
Date 6-17-79
Computed
Checked

JOB NO. 3290-02 BIRCHWOOD LAKE DAM

SQUARES 1/4 IN. SCALE

BIRCHWOOD LAKE DAM - STORAGE CALCULATION

ELEV.	AVERAGE H. [FT]	AVERAGE SURFACE [AC]	STORAGE [AC-FT]
551.1	8.	11.	88.
551.4	8.3	11.	91.3
552.	8.9	11.	97.9
552.5	9.4	11.	103.4
553.	9.9	11.2	110.9
553.5	10.4	11.2	116.5
554.	10.9	11.2	122.1
554.5	11.4	11.2	127.7

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SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

BIRCHWOOD LAKE DAM – SUMMARY

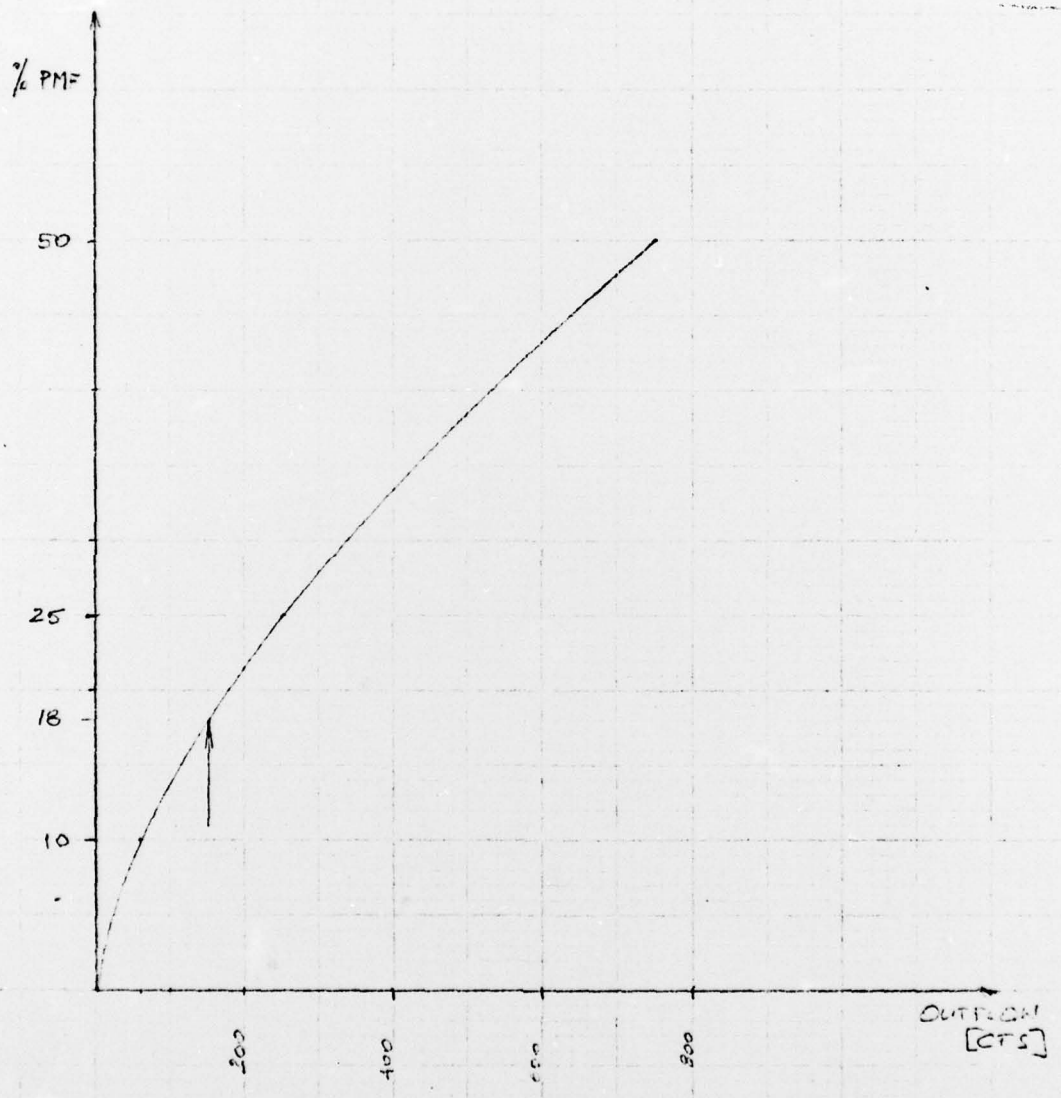
ELEV.	H (FT) ABOVE STOP LOGS	Q [cfs] DAM SIDE	Q [cfs] NORTHEAST SIDE OF THE LAKE	Q TOTAL	STORAGE [AC-FT]
551.0	0.	0.	0.	0.	88.
551.2	.2	.63	0.	.63	
551.4	.4	1.77	0.	1.77	91.3
551.6	.6	3.20	0.	3.20	
551.8	.8	5.00	0.	5.0	
552.0	1.0	5.5	17.7	23.2	97.9
552.5	1.5	5.8	95.6	101.4	103.4
553.0	2.0	38.3	255.	293.3	110.9
553.5	2.5	189.9	513.	702.9	116.5
554.0	3.0	565.3	833.	1398.3	122.1
554.5	3.5	1209.9	1175.	2384.9	127.7

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ANDERSON NICHOLS & CO. INC.
SUBJECT: H & H
COMPUTED: J.C2.
CHKD: FDD

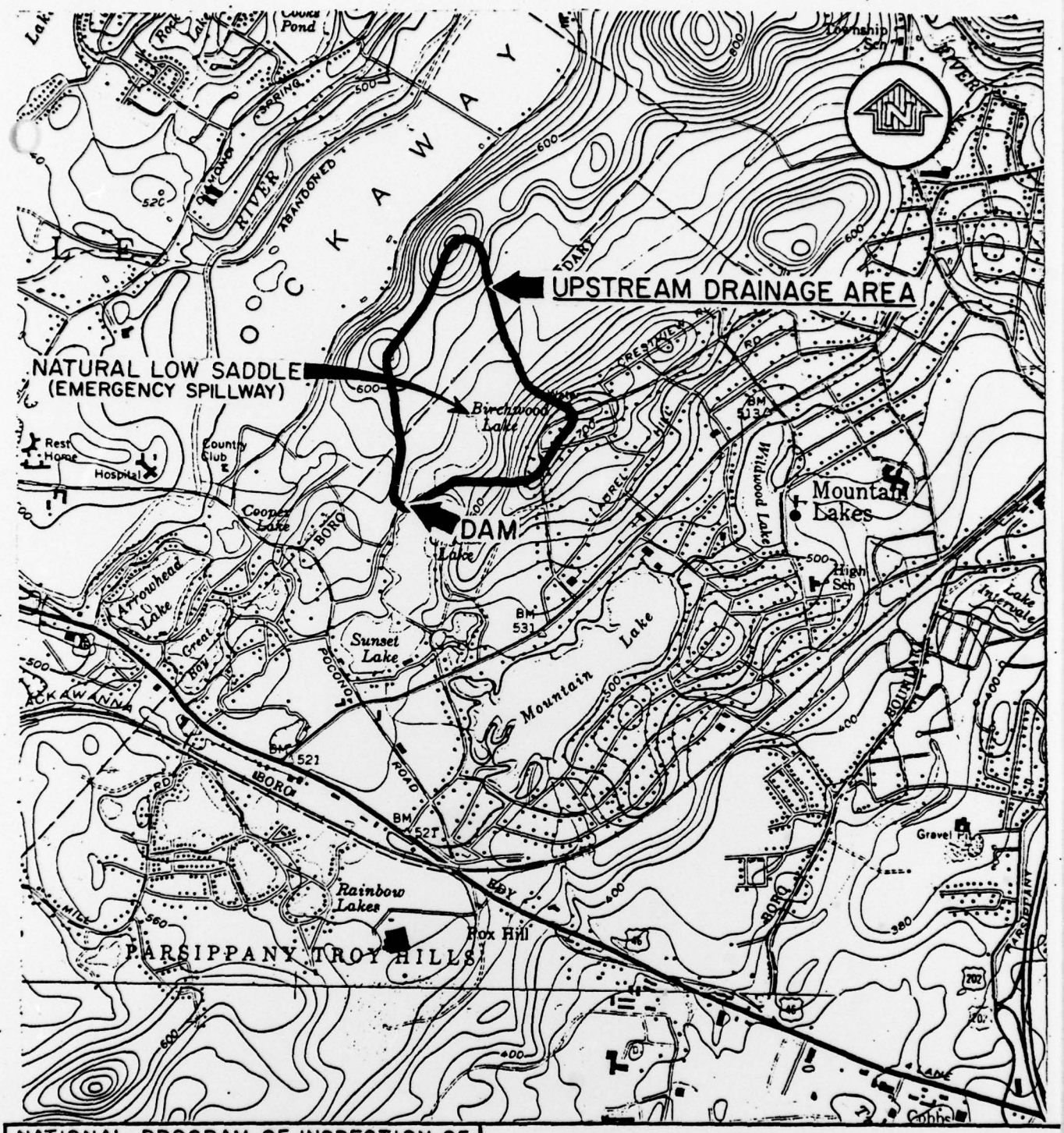
DATE: 07-31-[illegible]

BIRCHWOOD LAKE DAM TOPH 3.290-02



DAM OVERTOPS AT ELEVATION 552.7 FEET MSL
WITH Q = 156 CFS
∴ DAM CAN PASS ≥ 18% of PMF

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NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BIRCHWOOD LAKE DAM
BOROUGH OF MOUNTAIN LAKES

REGIONAL VICINITY MAP

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

ANDERSON-NICHOLS & CO., INC. BOSTON, MA.

SCALE IN MILES

0 1/2 1

MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE SHEETS. BOONTON, N.J., 1954, UPDATED 1970. MORRISTOWN, N.J., 1954, UPDATED 1970.

HEC-1 OUTPUT

BIRCHWOOD LAKE DAM

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1              A1JOB 3290-03 BIRCHWOOD LAKE DAM BOROUGH OF MOUNTAIN LAKES,N.J. NJ#25-70
    2              A2OVERTOPPING ANALYSIS ANDERSON-NICHOLS & CO. INC. CONCORD,N.H.
    3              A30.1, 0.25, 0.5 AND 1.0 MULTIPLES OF PMF FROM 6-HOUR PMF
    4              B     90       0       5       0       0       0       0       0       0       0
    5              B1     5
    6              J      1       4       1
    7              J1    .1      .25      .5     1.0
    8              K                      A1                              1       1
    9              K1DEVELOP INFLOW HYDROGRAHP FOR BIRCHWOOD LAKE
   10              M                       2      .2                               .8                      1
   11              O     72
   12              O1   .213    .213    .213    .213    .213    .213    .213    .213    .213    .213
   13              O1   .213    .213    .255    .255    .255    .255    .255    .255    .255    .255
   14              O1   .255    .255    .255    .255    .319    .319    .319    .319    .319    .319
   15              O1   .319    .319    .319    .319    .319    .319    .194    .388    .388    .581
   16              O1   .678   1.647   2.713   1.066    .678    .581    .388    .388    .298    .298
   17              O1   .298    .298    .298    .298    .298    .298    .298    .298    .298    .298
   18              O1   .234    .234    .234    .234    .234    .234    .234    .234    .234    .234
   19              O1   .234    .234
   20              T                                                              1      .1
   21              W2             .13
   22              X     -3
   23              K      1      A2
   24              K1OVERTOPPING ANALYSIS
   25              Y                              1       1
   26              Y1                                                    -551.1      -1
   27              Y4 551.0   551.2   551.4   551.6   551.8    552.    552.5    553.   553.5    554.
   28              Y4 554.5
   29              Y5             .63     1.8     3.2       5    23.2   101.4   293.3     703    1399
   30              Y5  2385
   31              $S    88    91.3    97.9   103.4   110.9   116.5   122.1   127.7
   32              $E 551.0   551.4    552.   552.5    553.   553.5    554.   554.5
   33              $$ 551.0
   34              $D 552.7
   35              K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	A1
ROUTE HYDROGRAPH TO	A2
END OF NETWORK	

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 79/07/26.
TIME= 19.55.11.

JOB 3290-03 BIRCHWOOD LAKE DAM BOROUGH OF MOUNTAIN LAKES,N.J. NJ#25-70
OVERTOPPING ANALYSIS ANDERSON-NICHOLS & CO. INC. CONCORD,N.H.
0.1, 0.25, 0.5 AND 1.0 MULTIPLES OF PMF FROM 6-HOUR PMP

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
99	0	5	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1

RTIOS= .10 .25 .50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

DEVELOP INFLOW HYDROGRAHP FOR BIRCHWOOD LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A1	0	0	0	1	1	0	0	

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	2	.20	0.00	.20	.80	0.000	0	1	0

PRECIP DATA

NP	STORM	DAJ	DAK
72	0.00	0.00	0.00

PRECIP PATTERN

.21	.21	.21	.21	.21	.21	.21	.21	.21	.21
.21	.21	.26	.26	.26	.26	.26	.26	.26	.26
.26	.26	.26	.26	.32	.32	.32	.32	.32	.32
.32	.32	.32	.32	.32	.32	.19	.39	.39	.58
.68	1.65	2.71	1.07	.68	.58	.39	.39	.30	.30
.30	.30	.30	.30	.30	.30	.30	.30	.30	.30
.23	.23	.23	.23	.23	.23	.23	.23	.23	.23
.23	.23								

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .13

RECESSION DATA

STRTQ= -3.00 GRCSN= 0.00 RTIOR= 1.00

TIME INCREMENT TOO LARGE--(NHQ IS GT LAG/2)

UNIT HYDROGRAPH 10 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .12 VOL= 1.00

253. 565. 410. 175. 80. 37. 16. 8. 4. 1.

0 MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.17	0.00	.17	1.	1.01	3.50	46	.46	.46	.01	1278.
1.01	.10	2	.17	0.00	.17	1.	1.01	3.55	47	.31	.30	.01	936.
1.01	.15	3	.17	0.00	.17	1.	1.01	4.00	48	.31	.30	.01	703.
1.01	.20	4	.17	0.00	.17	1.	1.01	4.05	49	.24	.23	.01	555.
1.01	.25	5	.17	0.00	.17	1.	1.01	4.10	50	.24	.23	.01	457.
1.01	.30	6	.17	.02	.15	6.	1.01	4.15	51	.24	.23	.01	401.
1.01	.35	7	.17	.16	.01	54.	1.01	4.20	52	.24	.23	.01	375.
1.01	.40	8	.17	.16	.01	142.	1.01	4.25	53	.24	.23	.01	364.
1.01	.45	9	.17	.16	.01	203.	1.01	4.30	54	.24	.23	.01	360.
1.01	.50	10	.17	.16	.01	230.	1.01	4.35	55	.24	.23	.01	358.
1.01	.55	11	.17	.16	.01	242.	1.01	4.40	56	.24	.23	.01	357.
1.01	1.00	12	.17	.16	.01	247.	1.01	4.45	57	.24	.23	.01	357.
1.01	1.05	13	.20	.20	.01	250.	1.01	4.50	58	.24	.23	.01	357.
1.01	1.10	14	.20	.20	.01	278.	1.01	4.55	59	.24	.23	.01	357.
1.01	1.15	15	.20	.20	.01	293.	1.01	5.00	60	.24	.23	.01	357.
1.01	1.20	16	.20	.20	.01	299.	1.01	5.05	61	.19	.18	.01	344.
1.01	1.25	17	.20	.20	.01	301.	1.01	5.10	62	.19	.18	.01	315.
1.01	1.30	18	.20	.20	.01	303.	1.01	5.15	63	.19	.18	.01	294.
1.01	1.35	19	.20	.20	.01	303.	1.01	5.20	64	.19	.18	.01	285.
1.01	1.40	20	.20	.20	.01	303.	1.01	5.25	65	.19	.18	.01	281.
1.01	1.45	21	.20	.20	.01	303.	1.01	5.30	66	.19	.18	.01	279.
1.01	1.50	22	.20	.20	.01	303.	1.01	5.35	67	.19	.18	.01	278.
1.01	1.55	23	.20	.20	.01	303.	1.01	5.40	68	.19	.18	.01	278.
1.01	2.00	24	.20	.20	.01	303.	1.01	5.45	69	.19	.18	.01	278.
1.01	2.05	25	.26	.25	.01	316.	1.01	5.50	70	.19	.18	.01	277.
1.01	2.10	26	.26	.25	.01	345.	1.01	5.55	71	.19	.18	.01	277.
1.01	2.15	27	.26	.25	.01	366.	1.01	6.00	72	.19	.18	.01	277.
1.01	2.20	28	.26	.25	.01	375.	1.01	6.05	73	0.00	0.00	0.00	232.
1.01	2.25	29	.26	.25	.01	379.	1.01	6.10	74	0.00	0.00	0.00	131.
1.01	2.30	30	.26	.25	.01	381.	1.01	6.15	75	0.00	0.00	0.00	58.
1.01	2.35	31	.26	.25	.01	382.	1.01	6.20	76	0.00	0.00	0.00	27.
1.01	2.40	32	.26	.25	.01	383.	1.01	6.25	77	0.00	0.00	0.00	12.
1.01	2.45	33	.26	.25	.01	383.	1.01	6.30	78	0.00	0.00	0.00	6.
1.01	2.50	34	.26	.25	.01	383.	1.01	6.35	79	0.00	0.00	0.00	3.
1.01	2.55	35	.26	.25	.01	383.	1.01	6.40	80	0.00	0.00	0.00	1.
1.01	3.00	36	.26	.25	.01	383.	1.01	6.45	81	0.00	0.00	0.00	1.
1.01	3.05	37	.16	.15	.01	357.	1.01	6.50	82	0.00	0.00	0.00	1.
1.01	3.10	38	.31	.30	.01	340.	1.01	6.55	83	0.00	0.00	0.00	1.
1.01	3.15	39	.31	.30	.01	387.	1.01	7.00	84	0.00	0.00	0.00	1.
1.01	3.20	40	.46	.46	.01	472.	1.01	7.05	85	0.00	0.00	0.00	1.
1.01	3.25	41	.54	.53	.01	598.	1.01	7.10	86	0.00	0.00	0.00	1.
1.01	3.30	42	1.32	1.31	.01	910.	1.01	7.15	87	0.00	0.00	0.00	1.
1.01	3.35	43	2.17	2.16	.01	1626.	1.01	7.20	88	0.00	0.00	0.00	1.
1.01	3.40	44	.85	.84	.01	2120.	1.01	7.25	89	0.00	0.00	0.00	1.
1.01	3.45	45	.54	.53	.01	1796.	1.01	7.30	90	0.00	0.00	0.00	1.
									SUM	20.41	18.86	1.55	29259.
										(519.)	(479.)	(39.)	(828.52)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2120.	406.	325.	325.	29254.
CMS	60.	11.	9.	9.	828.
INCHES		18.89	18.90	18.90	18.90
MM		479.70	480.00	480.00	480.00
AC-FT		201.	201.	201.	201.
THOUS CU M		248.	249.	249.	249.

HYDROGRAPH AT STA A1 FOR PLAN 1, RTIC 3

0.	0.	0.	0.	0.	3.	27.	71.	102.	115.
121.	124.	129.	139.	146.	149.	151.	151.	152.	152.
152.	152.	152.	152.	158.	173.	183.	188.	190.	191.
191.	191.	191.	191.	191.	191.	179.	170.	193.	236.
299.	455.	813.	1060.	898.	639.	468.	351.	279.	229.
201.	188.	182.	180.	179.	179.	178.	178.	178.	178.
172.	157.	147.	142.	140.	139.	139.	139.	139.	139.
139.	139.	116.	66.	29.	13.	6.	3.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1060.	203.	163.	163.	14627.
CMS	30.	6.	5.	5.	414.
INCHES		9.44	9.45	9.45	9.45
MM		239.85	240.00	240.00	240.00
AC-FT		101.	101.	101.	101.
THOUS CU M		124.	124.	124.	124.

STATION A2, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
2.	2.	3.	4.	4.	7.	15.	22.	34.	45.
55.	64.	72.	79.	86.	94.	102.	115.	127.	137.
146.	153.	159.	165.	169.	172.	174.	174.	176.	182.
196.	225.	291.	548.	731.	753.	656.	557.	459.	376.
311.	282.	266.	252.	241.	231.	222.	215.	209.	204.
200.	194.	187.	180.	174.	169.	164.	160.	157.	154.
151.	149.	146.	137.	122.	106.	95.	87.	79.	72.
65.	59.	53.	48.	44.	40.	37.	33.	30.	28.

STORAGE

89.	89.	89.	89.	89.	89.	89.	89.	90.	91.
91.	92.	93.	94.	95.	96.	97.	98.	99.	99.
100.	101.	101.	102.	102.	103.	103.	104.	104.	105.
105.	105.	106.	106.	106.	106.	106.	106.	106.	107.
107.	108.	111.	114.	117.	117.	116.	115.	113.	112.
111.	110.	110.	109.	109.	108.	108.	108.	108.	107.
107.	107.	107.	106.	106.	106.	106.	106.	106.	105.
105.	105.	105.	105.	104.	104.	103.	102.	102.	101.
101.	100.	100.	100.	99.	99.	99.	99.	98.	98.

STAGE

551.1	551.1	551.1	551.1	551.1	551.1	551.1	551.2	551.2	551.3
551.4	551.5	551.6	551.6	551.7	551.8	551.9	552.0	552.1	552.1
552.2	552.3	552.3	552.4	552.4	552.5	552.5	552.5	552.6	552.6
552.6	552.6	552.7	552.7	552.7	552.7	552.7	552.7	552.7	552.7
552.7	552.8	553.0	553.3	553.5	553.5	553.4	553.3	553.2	553.1
553.0	553.0	552.9	552.9	552.9	552.8	552.8	552.8	552.8	552.8
552.8	552.7	552.7	552.7	552.7	552.7	552.7	552.7	552.6	552.6
552.6	552.6	552.6	552.6	552.6	552.5	552.5	552.4	552.4	552.3
552.3	552.2	552.2	552.2	552.1	552.1	552.1	552.1	552.0	552.0

PEAK OUTFLOW IS 753. AT TIME 3.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	753.	184.	148.	148.	13277.
CMS	21.	5.	4.	4.	376.
INCHES		8.54	8.58	8.58	8.58
MM		216.99	217.85	217.85	217.85
AC-FT		91.	91.	91.	91.
THOUS CU M		112.	113.	113.	113.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

OVERTOPPING ANALYSIS

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A2	1	0	0	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
0	0	0	0.000	0.000	0.000	-551.	-1

STAGE	551.00	551.20	551.40	551.60	551.80	552.00	552.50	553.00	553.50	554.00
	554.50									
FLOW	0.00	.63	1.80	3.20	5.00	23.20	101.40	293.30	703.00	1399.00
	2385.00									
CAPACITY=	88.	91.	98.	103.	111.	117.	122.	128.		
ELEVATION=	551.	551.	552.	553.	553.	554.	554.	555.		

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
551.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
552.7	0.0	0.0	0.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .25	RATIO 3 .50	RATIO 4 1.00
HYDROGRAPH AT	A1	.20	1	212.	530.	1060.	2120.
	(	.52)	(	6.00)(	15.01)(	30.02)(	60.04)(
ROUTED TO	A2	.20	1	60.	255.	753.	1850.
	(	.52)	(	1.70)(	7.22)(	21.33)(	52.39)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	551.10	551.00	552.70
STORAGE	89.	88.	106.
OUTFLOW	0.	0.	178.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	552.24	0.00	101.	60.	0.00	4.08	0.00
.25	552.90	.20	109.	255.	.67	3.92	0.00
.50	553.54	.84	117.	753.	2.08	3.83	0.00
1.00	554.23	1.53	125.	1850.	4.75	3.75	0.00

APPENDIX 4

REFERENCE

BIRCHWOOD LAKE DAM

APPENDIX 4

REFERENCES

BIRCHWOOD LAKE DAM

1. U.S. Army Corps of Engineers, Hydrologic Engineering Center, "Flood Hydrograph Package (HEC-1) for Dam Safety Inspections - Users Manual", Davis, California, September 1978.

2. Brater, Ernest F. and King, Horace, Handbook of Hydraulics, Sixth Edition, McGraw-Hill, New York, 1976.

3. U.S. Bureau of Public Roads, "Design Charts for Open Channel Flow", October 1960.

4. Reference Data, Dams in New Jersey, No. 25-70 from NJDEP files, dated November 7, 1928.